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ABSTRACT

This document contains the following full and short papers on humanities and learning technology from ICCE/ICCAI 2000 (International Conference on Computers in Education/International Conference on Computer-Assisted Instruction): (1) "A Web-Based EFL Writing Environment: Integrating Information for Learners, Teachers, and Researchers" (David Wible, Chin-Hwa Kuo, Anne Liu, and Nai-Lung Tsao); (2) "Integrating Web-Based Materials into Course Design" (Lilly Lee Chen); (3) "Is Everyone on Board: Learning Styles and the Internet" (Michelle Hsiang, Ellen Storey Vasu, Marsha Alibrand, Nancy Atkins, and Jane Steelman); (4) "Research on Teaching Da-Yi Chinese Keyboarding by Using Adaptive Input Interface" (Ming-Chung Chen, Hwa-Pey Wang, and Lih-Ching Chen Wang); (5) "Strategies for Searching in the WWW" (Meng-Jung Tsai); (5) "The Internet-Based Educational Resources of the U.S. Federal Government" (Andy Wang and Krishelle Leong-Grotz); and (6) "Which Chinese Input Methods Is More Suitable for Sixth-Grade Pupils? Keyboarding or Non-Keyboarding" (Weichung Wang and Tainshu Ma). (MES)

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Proceedings

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A Web-based EFL Writing Environment: Integrating Information for Learners, Teachers, and Researchers

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With the rise in the popularity of web-based education, there is a pressing need for the design of web-based systems that are domain-specific. This need is particularly acute for the domain of second language education, where generic web-based systems fall short of fulfilling the potential of the Internet for meeting the particular challenges faced by language learners and teachers. A novel interactive online environment is described which integrates the potential of computers, Internet, and linguistic analysis to address the highly specific needs of second language composition classes. The system accommodates learners, teachers, and researchers. A crucial consequence of the interactive nature of this system is that users actually create information through their use, and this information enables the system to improve with use. Specifically, the essays written by users and the comments given by teachers are archived in a searchable online database. Learners can do pinpoint searches of this data to understand their individual persistent difficulties. Teachers can do the same in order to discover these difficulties for individual learners and for a class as a whole. The modular system provides interfaces with functions to facilitate an array of user tasks such as teachers' correction of essays and learners' writing and revision processes. Researchers' error analysis of learner essays feeds an active online help function as well.

Keywords: **applications in subject areas; architectures for educational technology system; interactive learning environments**

1 Introduction

The purpose of this paper is to describe one module in a highly integrated language learning environment called IWiLL (Intelligent Web-based Interactive Language Learning: http://www.can.tku.edu.tw/iwill) The module within IWiLL which we focus on in this paper is a novel web-based writing environment designed for EFL composition classes.

The design of the IWiLL writing environment is based upon certain general assumptions. First, the ideal online system for EFL writing classes should be interactive. Second, the system should exploit the computers' capacity to track the content of the interactions between users and to enable users to do pinpoint searches of the record of these interactions. This feature ma kes available invaluable information that can serve as a cumulative source of insight for both learners and teachers, information which in traditional writing classrooms remains scattered, ephemeral, and highly inaccessible. Third, while the system describ ed here is designed for second language writing classes, it is more accurately seen as one component in an integrated language learning environment that includes other skills, such as reading and listening (Kuo, Wible, and Chio, 2000; Kuo, et. al., 2000). The modularized and integrated design is intended to accommodate recent trends in language pedagogy which view language skills as best learned in an integrated whole rather than as a set of separate, independent skills. Finally, while the IWiLL environment is designed specifically to meet the needs of certain type of language course (second language composition) it is intended to provide as much freedom as possible for teachers within this domain to use their own approaches and materials of their choice.

2 The Organization of the System

2.1 The Teacher's View

A registered teacher who logs onto the system is presented a display screen of various links to components within the system. To correct student essays, the teacher links to a page which displays t heir student roster.

From this roster screen, the teacher retrieves the essay by clicking on the button that represents that essay on the roster page. To mark the essay with a comment (for example, to mark a run-on sentence or subject-verb agreement problem), the teacher first chooses the portion of the essay targeted for comment using the mouse. Once the relevant text has been selected, there are two ways for the teacher to provide the student with a comment on it. The first is to simply type the comment in the empty text box provided especially for the teacher's comment and then, once the comment has been composed, append it to the intended portion of the student's text by clicking on the appropriate button ('Give the comment'). The second way of providing a comment is to choose one that has been stored in a "Comment Bank." This second way deserves some elaboration.

The Comment Bank provides each teacher with a convenient means for storing and reusing frequently used comments. To retrieve a stored comment and append it to the portion of the student essay, the teacher simply selects that comment from a drop-down menu and clicks on it. The teacher can add new comments to her Comment Bank at any time. (See Figure 1)

At this stage, research is needed to understand the factors effecting how beneficial various sorts of comments are in helping students with their writing. An advantage of this system is that, with it, researchers can control the crucial variables (such as the precise form and content of the tea cher feedback being investigated), and it makes readily available the data needed for such research since the marked and unmarked essays are archived in forms that can be queried. Moreover, the revised versions of an essay can be examined along side the te acher's comments that were given to the student on the original version of the essay, making it possible to easily track the influence of various types of teacher feedback.

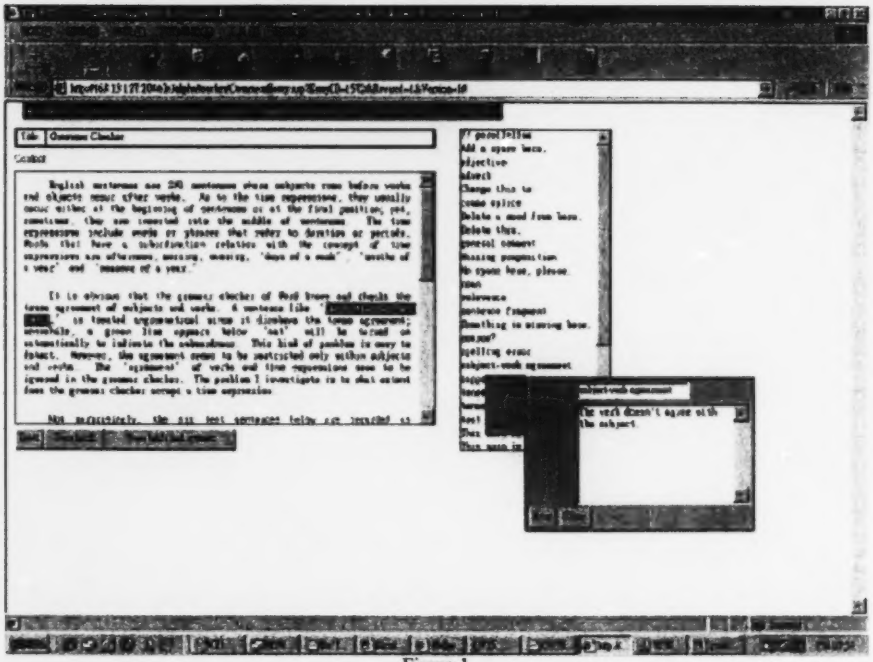

Figure 1

It is important to notice the distinction between this essay-marking function and the superficially similar functions offered in commercial word processors such as Microsoft Word. Like our system, those programs allow users to select portions of text and annotate them with comments. While the convenience that this provides to users as a communication tool is essentially the heart of the function's role in these commercial word processing systems, in our system this convenience is a relatively incidental (though valuable) advantage. For us, the substantial value comes from a set of related features which the word processing programs do not offer. Specifically, all of the annotations provided in our system by teachers when they mark essays are permanently indexed, by way of database technology, to the portions of text that the teacher has marked. Moreover, the essays themselves along with the indexed teacher comments enter a permanent corpus of learner essays that can be searched on line. Information extraction techniques, then, make it possible to provide learners and teachers with instant cumulative profiles of the trouble spots of individual learners, of whole classes of learners, or subtypes of learners selected by a wide variety of criteria. For example, the system enables teachers to retrieve all tokens that have been marked with a particular error type either from the essays of a single learner or from the essays of groups of learners. Moreover, teachers can retrieve the tokens of every error type and display them in order of frequency, with the error type that has been marked on the highest number of text portions listed first.

The role which our commenting function can play is deepened greatly by the highly integrated nature of our system design. Not only does it support profiles of entire groups of learners, but the analysis of the common errors can be immediately used by researchers to analyze the sources of learner difficulties. This sort of data makes it possible to investigate pervasive patterns of difficulty in the learners' English (that is, to investigate what some applied linguists call the 'interlanguage' of learners). Results of such analyses can directly enhance the entire web-based writing platform. Specifically, we have developed an authoring tool for designing online help which targets precisely the problems uncovered in the analysis of learners' errors. Moreover, based upon this sort of data, researchers can improve the design of teaching and reference materials. (See section 2.3 below for more details.)

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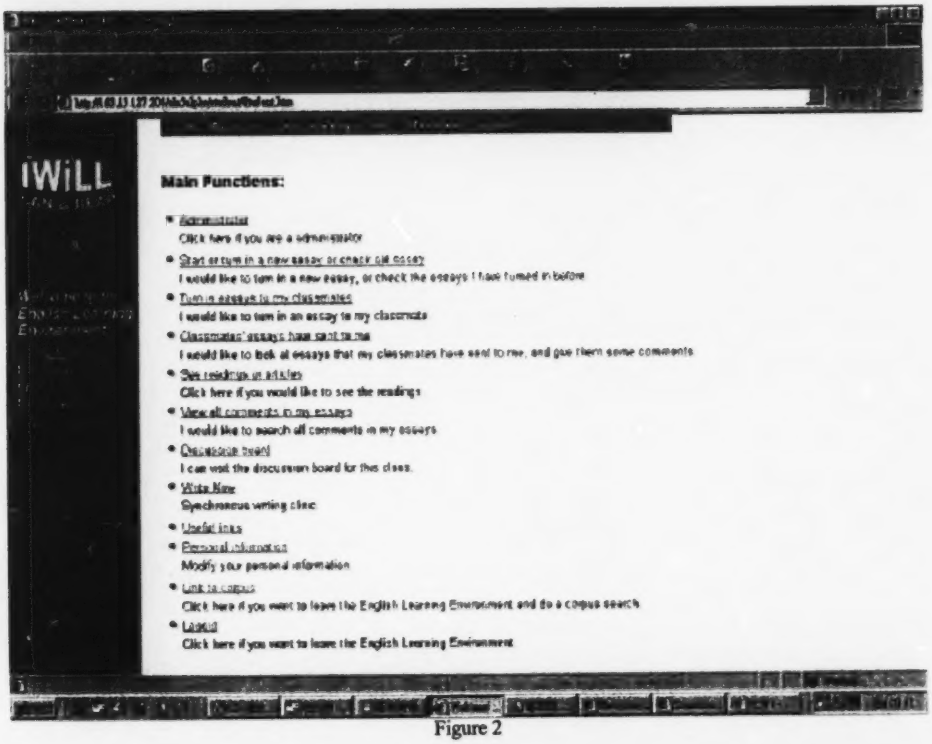
2.2 The Student' s View

A registered student logging onto the system is first shown a menu of links, including a link to a discussion board dedicated to the students in that class and links to helpful websites for ESL writers. To compose or turn in an essay, the student links to a page that displays a row o f colored buttons, basically each button (or cluster of buttons) representing a different essay the student has written or is in the process of writing. From this page, the student can opt to resume work on an unfinished essay or revision, or to submit or compose a new essay. (See Figure 2)


iWiLL
Main Functions:
Administrator
Click here if you are a administrator
Start or turn in a new essay, or check old essay
I would like to turn in a new essay, or check the essays I have turned in before
Turn in essays to my classmates
I would like to turn in an essay to my classmate
Classmates' essays have sent to me
I would like to look at essays that my classmates have sent to me, and give them some comments
See readings or articles
Click here if you would like to see the readings
View all comments in my essays
I would like to search all comments in my essays
Discussion board
I can visit the discussion board for this class.
Write Now
Synchronous writing clinic
Useful links
Personal information
Modify your personal information
Link to corpus
Click here if you want to leave the English Learning Environment and do a corpus search
Logout
Click here if you want to leave the English Learning Environment
Figure 2

To compose an essay, students can elect either to compose online by typing their essay within a designated text box on the appropriate page or to copy and paste into that box an essay composed off-line. The latter essays are imported as text files.

From this screen where the essay has been composed or imported, students can submit the essay to the instructor. Alternatively, through a drop-down list of all of their classmates' names they can send the essay to any number of their classmates for peer editing or commenting. The methods of selecting portions of text for comment and for submitting comments are basically the same as under the teacher' s view described above.

When a student views an essay that has been marked by the teacher, the essay itself appears almost identical to the student's original, unmarked essay. None of the teacher' s comments are immediately visible. The only difference in the appearance of the marked and unmarked version of an essay is that in the 'corrected' version some of the student's text shows up in blue. These are portions of the essay that the teacher has marked for comment. To see the content of the teacher's comment, the student places the cursor on the blue text and the comment appears.

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An important feature offered to students is a specific sort of search function which they can access through a link labeled: "Search all comments in my essays." With this function, a student can access a list of all of the comments that the teacher has marked on his essays. The comments are listed in descending order of frequency as they occur in the entire set of that particular student's essays.

By clicking on the View button for any of these comments that appear on this display, the student retrieves a cumulative listing of all of the instances where this comment appeared in his own essays. To give the minimum context that would allow the student to see the nature of the marked problem, this search function retrieves complete sentences from the student's texts even if the teacher had marked only a word or phrase or other proper subpart of that sentence for comment. In instances where the teacher has marked off a chunk of text which spans a sentence boundary in the student essay, the entire text of both (or all) of those sentences is displayed. By clicking on any of the tokens that have been retrieved, the student links to the complete text of the essay from which that token was extracted, thus accessing the full context.

What the "View Comments" function provides is the opportunity for the student to see patterns of difficulty, to see in one glance a set of tokens of one type of difficulty from his own writing. Of course, what is needed here is research on the differential effects of the two approaches to providing feedback. Moreover, the effectiveness of the View Comments function will almost certainly depend not simply on the fact that the system allows searches of the essays according to teacher comments, but also upon the quality and clarity of the comments themselves. An important property designed into the system is that it can track precisely the kinds of data needed for investigating these sorts of issues.

2.3 The Researcher's View

The system has been designed to create a corpus of student essays as a byproduct of the teacher-student interaction on the system. Specifically, each essay that a student submits to his teacher over this system is, with the permission of that student, copied into a corpus of "learner English." Consequently the corpus itself grows as the system is used by students and their teachers.

The creation and analysis of corpora of learner language data is an extremely new and promising field of research (see Granger 1998). One of the formidable obstacles in this field is a practical one of how to input the learner data. Granger (1998:11) mentions three methods, all extremely tedious, time-consuming, expensive and the first two prone to error: (1) scanning essays from hard copies and (2) keying in data manually (3) downloading electronic data. Granger implies that the latter refers to collecting student essays that are on disks. Our system offers another way of creating learner corpora which goes a long way toward eliminating these prohibitive drawbacks. The texts created by students enter the corpus virtually unaffected by any intermediate steps for "inputting" them because the exact text that the student sends to the teacher over the system is copied into the corpus. Moreover, when students first register to use the system, they provide relevant metadata about their years of studying English, their gender, age, mother tongue, and the relevant fields of metadata are updated every semester. Each essay a student turns in is automatically indexed to this information and annotated with the date when that specific essay was submitted. This indexing allows for longitudinal studies of learner writing as well as cross-sectional studies that consider variables such as gender, age, or years of study. Researchers can add other fields of metadata to track other variables for specific studies.

Researchers are not only able to search the corpus of essays collected from learners. The results of the researcher's analyses of learner difficulties can be translated into the content of an active online help function for those learners. The system includes an authoring environment for content administrators (ICPs) where they simply indicate what string of text in a learners essay should trigger help, and then write the content of the help which should be displayed for that particular string. Research on the learner corpus has revealed, for example, that the word 'ever' was misused by learners in 25% of the cases where it appeared in their essays. Further analysis attributed this to negative transfer in which learners associated the English expression 'ever' with a Chinese counterpart expression (*cheng jing*). These two expressions while overlapping in use and meaning, diverge in important ways, and it is precisely in these diverging respects where students misused the English expression. Based on this linguistic analysis, the authoring environment for online help was used to design advice concerning the word 'ever' addressing precisely the difficulties it poses for Chinese learners. When learners request general help on an essay, the help function actively detects instances of 'ever', highlights them

and creates a link to this advise.

3 Conclusion

The underlying goal of the project described above has been not only to create an online writing environment that connects teachers and students by way of a user-friendly interface, but also to provide ways to exploit the valuable data that is created when the environment is used. The learners' essays themselves are stored in growing corpus of ESL language production. The comments that teachers append to the particular segments of the learners' texts in the course of essay correction are treated as annotations of those texts, which can be searched and retrieved. An authoring environment for online help permits content administrators to turn interlanguage research results into highly specific help concerning attested difficulties which traditional language education has neglected. It is hoped that increasingly sophisticated and dynamic manipulations of these sorts of data will lead to the delivery of evermore useful and useable information to learners, teachers, and researchers both online and off.

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Integrating Web-based Materials into Course Design

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1 Introduction

This paper is a report on a project in which Web pages were crucially incorporated in the design of a new college course titled anguage and Culture in Taiwan." There were two main reasons for making the Internet an integral part of the course: (1) the wide range of topics covered in this very general introductory course requiring the wealth of information sources easily accessible on the Internet and (2) necessity of frequent updates of information due to the fast and volatile nature of the political evolution in Taiwan, particularly during the presidential election year when this course was offered. The consideration of user factors was also important. The Internet responds well to today's college students who demand relevance (of issues that pertain to the here and now) and immediacy, and are as adept in clicking on the keyboard surfing the Internet as flipping the pages of a book.

More serious, though, in our course design is the educational philosophy that a college's mission is not so much to transfer knowledge as to create environments and experiences that bring students to discover and construct knowledge for themselves [1]. Exposure to the vast amount of knowledge on the Web necessitates focus and careful choice of relevant materials. As part of course assignments students were expected to present on topics of their choice. This ensured that they researched the subject matters in greater depth before presenting them in class, as they would be presenting to an audience of their peers.

2 Method and content

The ready accessibility of the Internet for both the students (practically all students have a PC) and instructor (to add to or update the course page), especially outside of class, altered in-class activities from those of traditional teacher-centered instruction to student-centered discussion and presentation. The utilization of e-mail also facilitated out-of-class preparation. Students were informed by e-mail to go to a certain new site or link for a new development of events. Similarly, the student e-mailed the instructor for information or help. The more out-of--class preparations the students have, the better the quality of in-class discussions the instructor can expect.

The syllabus was essentially a structure of links organized according to the class schedule of topics and activities. It is also a display of the scope and structure of the contents of the course. It changed dynamically as new links were discovered and added throughout the semester. The syllabus appears as a navigation bar. To facilitate learning we have minimized visual search by displaying this syllabus bar consistently on top of each page[2]. Students can easily navigate from site to site, not only to preview but also to review. Besides a general page of topics with their links to available Web sites, the page of each session further highlights some particular links to topics of the session, along with a list of references available on reserve in the library.

The contents of this course consist of two major areas: (1) culture and (2) language. The former includes a wide range of topics, such as a profile of Taiwan, history, political parties, customs, festivals, family relations, literature, world view of Taiwan, and the future of Taiwan. Generally each topic or a group of related topics was covered at a weekly session, which lasted two and a half hours, of which the first half was devoted to cultural discussions and the second half, instruction of language. The culture part of the course

was conducted in a seminar format along with presentations by students.

By dividing the content area into culture and language, we were not forgetting that language always operates in a culture [3]. Besides teaching phrases and sentences applicable in social situations, other aspects of the language, such as kinship terms, nursery rhymes, proverbs, songs, etc., abounding with traditions and cultural values, were also taught. The language part of the course contained sound files. Some had two types of reading, a slower one and a faster one, to facilitate learning. Taiwanese expressions in each language lesson generally contain both literal and free translations. This makes self-study very easy and convenient, as long as they could access the Web. Sound files were indispensable as Taiwanese is a tone language and furthermore has seven tones and possesses an elaborate tone sandhi system [4].

This Web program was produced entirely in the instructor's office by using Netscape Composer, SoundRecorder, and other freeware downloaded from the Internet [5]. The exercise part of the course, which features filling in of blanks, multiple choice, short answer, etc., was made possible by the ExTemplate program developed at Rice University Language Resource Center [6]. The ExTemplate application creates exercises that will be stored in a database for future retrieval [7]. It allows students to submit exercises via the Internet and be graded by the instructor also via the Internet. The language lesson sound files were integrated into ExTemplate. This feature was very useful particularly for tonal distinction exercises.

Our classroom was equipped with a multimedia Podium which allowed us to go on the Internet, show videos, movies, documents, play CD , etc. The Podium came in handy when a demonstration on the classroom screen was called for. Not only did the instructor use the Podium, students were encouraged to do their class presentations by using PowerPoint or by going to their own personal homepages where they collected Web links or images related to their topics for classroom presentation.

3 Conclusions

By incorporating the Internet into course design, we were able to create a more accommodating learning environment for the students and to give students more control over the learning process. As this was our fist attempt at teaching the course with Web-based materials, further refinements of many aspects of the course need to be made. For example, we can make pages less cluttered with text and add more digitized videos. Also researches can be conducted to determine students' reactions in terms of attitudinal factors and learning efficiency. Taiwanese on the Web is an on-going project. We solicit help and comments. This project attempts to raise awareness in the global community of the vitality of a culture less known and rarely covered in college courses. As universities generally suffer from budget constraints, by making this program available on the Web we hope to encourage teaching of this subject matter.

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Is Everyone on Board: Learning Styles and the Internet

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For many years, educators and practitioners have been implementing, enhancing and innovating variety of teaching methods to best fit students learning styles for eliciting the potential of students. As stated by Corno and Snow [2], "the success of education depends on adapting teaching to individual differences among learners", the teaching methods taught are to accommodate, meet, and elicit the diverse learning needs. Technology is becoming accessible to most segments of the United States population. As more and more classrooms are connected to the Internet and online-lesson plans are adopted to teaching and learning, it is important for teachers to ensure that the diverse needs of every student is addressed. This research study contained the quantitative analyses relative to learning styles and web design.

Keywords: **Humanities and Learning Technology, Instructional Design, Web-Based learning**

When computer technology increased its popularity in 1980's, Computer-Assisted-Instruction (CAI) in the form of drill, practice and tutorials was superior to traditional instruction [1] and outperformed those who received traditional instruction [7]. While providing feedback to reinforce learning in CAI, Pritchard [6] recommended that the use of computers in CAI require a specific learning style of paying attention to details for accuracy, so that students are able to work alone. Davidson et al [3] further examined learning styles and performance in computer concept and programming skills in BASIC, and found that learning styles had a significant effect on performance of a computer course. By 1997, 72% of the schools in the USA had online access. As teachers adapt their teaching to the use of the World Wide Web as a medium for resources, and to publish their class websites, the information delivery system has been changed from paper format to digital format and from fixed text to unlimited hypertext. The visual graphic representation has been switched from static to animated/multi-dimensional and from limited colors to millions of colors. With the advance of the technology, sound and movies can be incorporated into webpages to enhance teaching and learning environment. With the release of many HyperText Markup Languages (HTML) editors, e.g., Adobe PageMill, DreamWeaver, Front Page, it becomes very easy for anyone to create and publish webpages, therefore it is essential for educators to investigate the different learning styles of individual students when designing webpages.

Study Purpose and Sample Setting

The purpose of this study is to examine two different webpage designs regarding to students learning styles. A total of 44 students who enrolled college courses in graphic design, computer application and web design were selected in the study. Students in these classes had little or some knowledge of the Internet and Webpage design.

The two web designs were developed by the authors and used for the study: one-frame versus two-frame designs with the incorporation of colors, animation, buttons, and hypertexts. The one-frame design used a top-down sequential technique for web design. To begin, users must access from the main menu in order to navigate to other pages. The two-frame web design contained two displays located side-by-side. The left-frame normally contains the potential links, the right-frame displays the corresponding information. Users can make random selection of different links at any given time provided on the left-frame that served as the main menu.

Measurement and Procedures

In the beginning of the semester, the Gregorc Style Delineator [4] was administered and the scores were tallied to determine students prefer learning styles in (1) Concrete sequential; (2) Abstract sequential; (3) Concrete random; or (4) Abstract random. At the end of the semester, students were given an Uniformed Resources Links (URL) to review the two different styles of web designs as mentioned earlier. After review, an instruction was provided for the students to fill out an open-ended questionnaire to reflect their selection and to make their comments.

Selected Results:

Two-frame selection: Students preferred the two-frame design to the one-frame arrangement with a ratio of approximately 3:1. This again stressed the importance of design in CAI that emphasized gaining attention, guiding learning, informing learners of objectives, and presenting stimuli with distinctive features. The reasons why users were in favor of the two-frame design included that it was easier to navigate with left-frame controlling the right-frame. With all the links listed on one-frame and information displayed on the other, it provided a quick access to the viewer.

One-frame selection: Students who preferred the one-frame design to the two-frame one like the fact that it was easy to follow and less confusion, simple but effective. Information straight down on a page was easier to read and to understand than a two-frame design. It kept attention intact and was readily for research. Some found that it was easy to use for computer illiterate people.

Discussion

The two-frame design is a newer approach than the single frame design. Students used to the one-frame design and some still prefer the same way of accessing information, even though the two-frame design has pleasing results and is reportedly easier to use than the one-frame design. In summary, this research suggested that the major reasons why the students disliked the two-frame design were because they were simply unfamiliar with the structure. Additional training and more exposure to the two-frame design would help them overcome the barrier. As the popularity of the Internet increases and the HTML editors become easier to use, it is important to emphasize these design factors, so that the webpages can be designed more accessible and user friendlier as technology advances.

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Research on Teaching Da-Yi Chinese Keyboarding by Using Adaptive Input Interface

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The purpose of this study was to examine the effects of teaching three students with moderate mental disability in a specialized high school in Taiwan to learn Da-Yi Chinese keyboarding by using adaptive input system. A single-subject multiple-probe baselines design across subjects was used. The students used the Unlimiter system as the adaptive input interface to learn to differentiate the locations of the Da-Yi character roots on a keyboard and to learn Chinese keyboarding with Da-Yi character roots. The result shows that all three students can distinguish the locations of the Da-Yi character roots without extra instruction and interact with the computer with Da-Yi input method. The applicability and effectiveness of teaching high school students with moderate mental disability in learning Da-Yi Chinese keyboarding was supported.

Keyword: **adaptive computer system, Da-Yi Chinese Keyboarding, special education, mental disability**

1 Introduction

With the rapid advancement of the Internet, our life has become more tied to the Internet and the utilization of the computer is becoming increasingly important. In daily life, people are becoming more familiar with Internet shopping and using email to communicate. In educational planning, many countries are putting emphasis on classroom computers and the Internet [5][6]. Moreover, various Internet-based learning modes are the focus of research in those countries [12][13] in hope of using the Internet to assist students to learn anytime and anywhere and are consequentially achieving the ideal of equal educational opportunity and quality education.

However, for the disabled, because of their disability in the functions of the body, senses, and cognition, it is hard for them to use the technology of computers and the Internet. Enabling the disabled in utilizing these technologies with an accessible environment is an important issue facing the educators.

The government in Taiwan views the establishment of a computer environment with accessibility for the disabled as a priority. When the Department of Education started putting the infrastructure of computer classrooms and Internet access in place in K-12 schools in 1998, it purchased a batch of computers with specialized Internet accessibility for the local school districts and special education schools in hopes that the disabled students can use the specialized equipment to learn computer skills and the Internet, thus enabling them to further their learning with the help of the computer and Internet.

Specialized computer accessories can reduce the problems that the disabled encounter in input and output so

that they can use the computer more easily. Therefore, as far as input device accessibility is concerned, the emphasis is on the input interface, for example, keyguard, touch-screen, trackball, replacement keyboard -- mini-keyboard and enlarged keyboard, etc. Although these input devices make the computers more accessible and easier to use, no matter which accessible input interface is employed, a user still has to learn a method of Chinese input to be able to use the computer in learning and communications.

Currently, four kind of Chinese input mechanisms are used: keyboarding, voice input, writing input, and optical scan. Keyboarding is the most common input method among them[4][14][15]. In fact, although the other ways are more convenient , keyboarding is more useful for individuals with more severe mental disability, since they experiences difficulty with cognition, speech, and motor skills [8][9].

Whichever input method is employed, keyboarding has to be utilized to complete the process of interfacing with the computer in Chinese. Furthermore, keyboarding, per se, is not restricted to finger typing on a keyboard. It is broadly viewed as using the key codes on the keyboard to spell characters and words. A user can input by clicking the keys with a mouse on a displayed mini-keyboard on the computer monitor, by using a replacement keyboard, by using a single on/off key in conjunction with menu scanning, or even by using Morse code. Thus, it is an important key issue to know how to help the disabled, intellectually and/or physically, to learn effective computer keyboarding that enables them to communicate with people.

There are several methods for typing Chinese characters on the computer. These input methods can be grouped into two categories: One is phonetic-coding input; the other is pattern-coding input. The former is inputting Tzu-Yin phonetic symbols or Han-Yu phonetic spelling to have the computer display the homonyms, while the latter is inputting the codes of disassembled basic character patterns, for example, Chang-Jay pattern coding and Da-Yi pattern coding to have the computer display a corresponding Chinese character. Among the current methods, Tzu-Yin, Chang-Jay and Da-Yi are most commonly used[3].

The authors chose Da-Yi as the input method in this study based on the reasons below:

A. The prerequisite of using Tzu-Yin input method is that one must be able to pronounce and spell out a character[7]. This is difficult for students with mental disabilities.
B. Chang-Jay input method was developed based on the character-construction rules while Da-Yi keyboarding starts with writing-stroke rules. This way, the students could keyboard with the sequence of writing.
C. Some research results show that students with mild mental disability perform worse in using Tzu-Yin keyboarding than in using Chang-Jay [10]. The students spent a lot of time learning. Students with moderate mental disabilities could learn to use the Da-Yi input method quickly.
D. Da-Yi input method may be worthwhile for students with mental disabilities to learn in the information age. But how can we assist the students in learning Da-Yi more effectively and less frustratingly?

Therefore, the purpose of this research was to explore if the students can learn to use the Da-Yi input method on the keyboard.

2 Research Methodology

2.1 Experimental Subjects and Setting

Three high school students with moderate mental disability in the Chia-Yi special school participated in this research. The subjects were selected on the basis of three criteria. First, they were capable of using verbal communication. Secondly, their emotions were stable. Thirdly, their fine motor movement, especially that of the hands, could be controlled by themselves.

Although they are too old to take an IQ test, they were all identified as having moderate mental disability when they entered this school. In order to realize the subjects' characteristics, the researchers reviewed their IEP files and interviewed their teachers. A summary of the subjects' characteristics appears in table 1.

Instruction was conducted by the researchers in the school's counseling room. A personal computer with an Unlimiter computer interface system (called the U1 system by special education educators in Taiwan) were placed on the table. The U1 system was designed by the Assistive Technology Foundation. It is a kind of programmable keyboard that can be designed by the instructor[2]. The subject sat in front of the table and operated the U1 system while the instruction took place.

Table 1 Subject's Characteristics

Subject	Age	Grade	Gender	Experience in Computer Use?	Performance of literature
• •	17y4m	12th	Male	Yes	Can read and write some common words, Articulation disorder Received speech-language therapy.
• •	17y11m	12th	Female	No	Can read and write some common words, oral expression is good
C	18y7m	10th	Male	No	Oral expression is good. Can read printed words excluding his personal information, e.g. name, address.•

2.2 Stimuli

2.2.1 Character roots instruction

There are 253 character roots in the Da-Yi input method. These character roots are divided into 40 groups depending on their attributes. The researchers chose the most frequently used 2 characters for each group, which were a total of 80 characters (see Figure 1).

2.2.2 Keyboarding instruction

328 words that were divided into 4 sequent groups according to the construction of the word were chosen for the keyboarding practice. These four groups are: group A "from left to right" (•), group B "from top to bottom " (•), group C "combination of the previous two types" (•), and group D "from outside to inside" (•). These words were chosen based on their frequency of use and the explicitness of the word formation. The subjects practiced keyboarding from easier character root formations to more complicated ones.

2.2.3 Words for generalized testing

Three groups of tests were designed. The first group contained 28 new words that were never practiced before. The second involved 21 sentences and 172 words that were practiced in the instruction period. The third group were some written articles.

2.4 Apparatus

This study uses a multimedia computer with a 19-inch monitor and Unlimiter, an adaptive input system. Unlimiter is a kind of programmable keyboard for which the user could design the layout to suit their purpose. In this study, the researchers designed a layout as an alternative keyboard for the subjects. The content of the layout is in Figure 2.

2.5 Definitions of Independent and Depe ndent Variables

The independent variable was the instructional design that contained the arrangement of the keyboarding practice words based on the explicitness of word formation and the use of the Unlimiter computer input system.
The dependent variables were effectiveness of learning (percentage of correctly keyboarded target words) and efficiency of learning (numbers of sessions the subject required in order to reach the master criteria).

Figure 1 the table of Da-Yi character roots

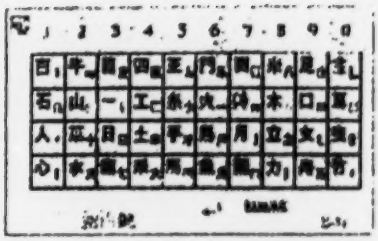

Figure 2 the layout of Da-Yi input method

2.6 Design

A multiple-probe baseline across subjects was used. The particular strengths of the multiple-probe baseline design were: (a) the treatment was not reversed, (b) prolonged baseline measures were unnecessary, and (c) the design permitted the evaluation of academic learning [1][11]. A constant time delay technique was selected for instruction in this study, and verbal praise was used as reinforcement.

2.7 Procedure

The research was divided into two steps: instruction of Da-Yi character roots followed by the instruction of the Da-Yi input method. Researchers randomly decided prior to the instruction which subjects would receive instruction. The next group of subjects received instruction when the previous student group entered the "from upper to lower" keyboarding instruction.

2.7.1 The instruction of Da-Yi character roots

In this step, subjects learned about the 80 Da-Yi characters roots on the layout. The subject would not go to the second step, the instruction of the Da-Yi input method, until he or she reached the master criteria, which was 90% correct responses in three continuous sessions.

2.7.2 The instruction of the Da-Yi input method

There were three periods of instruction. They were baseline, instruction sessions, and maintenance & generalization. During the baseline period, the subjects were measured on their accuracy of keyboarding with the Da-Yi input method. The percentage correct measured after testing each group of target words was used as the subject's baseline performance.

During the instruction sessions period, researchers taught the students the necessary keyboarding rules for the sequence of writing. The instruction started from group A"from left to right". The subject practiced and took a test with the *Microsoft Excel* software. The researchers demonstrated keyboarding the target word if the student could not keyboard it correctly in the 20-second time-delay period. The student could not advance to practicing the next group until he or she reached the master criteria, which was a 90% correct response in three continuous sessions.

In order to examine whether the subjects could maintain and generalize their keyboarding abilities, we continued to assess the subjects' performance of new words, sentences and articles without prompting.

2.8 Reliability

In order to assess the subjects' response accurately, we immediately recorded the results of subjects' keyboarding in *Microsoft Excel*.

3 Result

3.1 Da-Yi Character Roots

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The three subjects were measured for their familiarity with Da-Yi character roots by having them indicate the target key on the layout. The results showed that all three students could indicate the 80 character roots under the researchers' order. It meant that the subjects could go to learn Da-Yi input method without supplemental learning of character roots.

3.2 Keyboarding- Four groups of words

The percentage of correctly keyboarded training words in the four groups during the instruction sessions for each subject is presented in Figures 3, 4, and 5. For these three subjects, it is obvious that they could learn to keyboard with the Da-Yi input method. Student A could type these four forms of words almost 100% correctly. The performance of Student B indicated that she fulfilled the criteria in every measurement except the first trial of group A and group D.

Student C only fulfilled the mastery criteria for group A. However, student C could reach the mastery criteria and learn how to keyboard with the Da-Yi input method.

According to the performance of these three subjects, we found that teaching keyboarding to moderately mentally disabled students with the Da-Yi input method using Unlimiter as an adaptive input system is a valid method, especially when student C did not recognize these characters.

The instruction was efficient. Student A reached the mastery criteria in the minimal number of sessions. Student B used three sessions for groups B and C, and four sessions for groups A and D. Student C spent three sessions on group A, four sessions on group C and group D, and five sessions on group B. They all could learn to master the keyboarding rules with the Da-Yi input method with short-term instruction.

3.3 Maintenance & Generalization.

3.3.1 New words

The subject was measured on their generalization of a group of new words after their mastery of the four groups of words with different word formations. The results are presented on table 2. They could generalize the rules of keyboarding for words not practiced before.

3.3.2 Sentence

Students were asked to keyboard 21 sentences and 172 words composed of the words they practiced. The results on table 2 indicate that the three subjects could keyboard almost 100% correctly.

3.3.3 Articles

Due to time limitations, student B only finished article one, and student C did not have the opportunity to type the articles with the Da-Yi input method. As the results in table 2 show, student A and student B could keyboard almost all the content of the articles although some words were never practiced.

Therefore, the three subjects could generalize the rules of keyboarding with the Da-Yi input method they had learned into new words, sentences, and articles.

Table 2 Numbers of correct inputting of the three subjects in generalization test

	New words (n=28)	Sentences (n=172)	Article one (n=130)	Article two (n=227)	Article three (n=142)
Student A	28	172	127	225	136
Student B	25	170	125		
Student C	24	172			

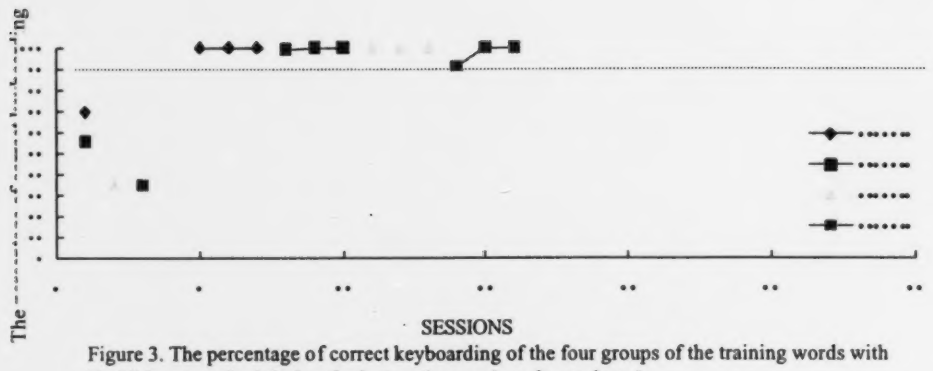

Figure 3. The percentage of correct keyboarding of the four groups of the training words with Da-Yi input method during the instruction sessions for student A

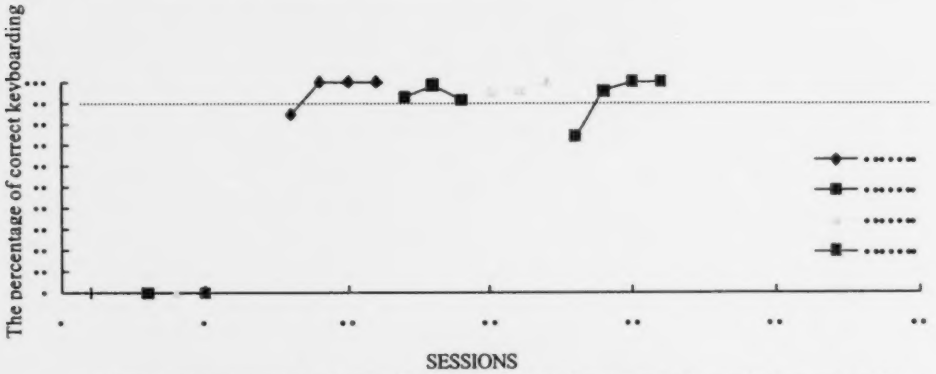

Figure 4. The percentage of correct keyboarding of the four groups of the training words with Da-Yi input method during the instruction sessions for student B

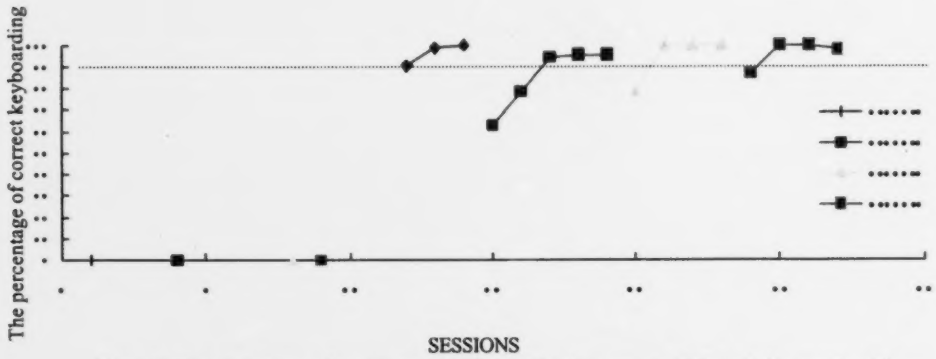

Figure 5. The percentage of correct keyboarding of the four groups of the training words with Da-Yi input method during the instruction sessions for student C

4 Conclusions

The purpose of this study was to examine the effects of teaching students with moderate mental disability in a special high school to learn Da-Yi Chinese keyboarding by using an adaptive input system. The results indicated that all three subjects could learn to keyboard with Da-Yi input method by using adaptive input system. In other words, it was an effective and an efficient way to teach students with moderate mental disability to learn Da-Yi input method by using adaptive input interface. In fact, using the alternative keyboard could provide the students with a simpler keyboard, but more prompts would be needed to discriminate the position of the Da-Yi character roots.

According to the result of this research, special educators may help students with moderate mental disability to learn Da-Yi Chinese keyboarding by using an adaptive input interface system as an input method.

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Strategies for Searching in the WWW

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Searching information in the WWW effectively and efficiently is an important vehicle for 21st century citizens to become lifelong learners. This study was to identify effective information-seeking strategies by comparing the strategies employed by the Internet novice user and those by the expert user. A searching task followed by an interview were undertaken in order to observe the strategies used by the subjects. Pre-task and post-task surveys were also administered to collect data relating to subjects' background and self-efficacy toward using the Internet. Protocol analysis was used to analyze the verbal data collected in this study. The results showed that the expert and the novice employed different information-searching strategies in the following six aspects: computer self-efficacy, task anxiety, search aids, information processing, concentration, and problem solving.

Keywords: **Searching Strategies, Lifelong Learning, WWW**

1 Introduction

Lifelong learning has been recognized as an important goal of education in the twenty-first century [14]. With increasingly tremendous information to face everyday, searching desired information effectively and efficiently becomes a necessary skill for learning in such an information age [4, 6]. Due to its efficiency and popularity, the World Wide Web (WWW) is becoming a powerful vehicle for reaching the goal of lifelong learning.

However, it seems not easy for Internet novice users to search information effectively and efficiently via the web. For example, disorientation was reported as a problem that the novice explorers might have while navigating within a hyperspace [2]. It was often to lose directions if they were lack of self-conscious in searching motivation, strategies, results, and meanings. Borgman suggested future research to compare novice and expert users' cognitive behaviors while they are doing a specific searching task in order to find the key factor to accomplish the task [1].

Prior research indicated that users' metacognitive ability, orientation conscious, system knowledge, domain knowledge, and system design influenced users' searching strategies while navigating in a hypermedia environment [6, 10]. Users' computer knowledge and information processing skills were particularly emphasized as important factors to determine a successful searching [4]. Except by improving the system design to help users perform self-reflection during the information-seeking process [9, 7], future research was suggested to evaluate the application of metacognitive skills in an Internet-based learning context [4, 5].

According to the literature about metacognitive strategies [12, 16], learners need not only to have self-conscious about their own learning but also have to know what strategies they can use and how to use them in order to enhance their metacognitive abilities. In addition, it is more important for students to know how to learn than what to learn in order to reach the goal of lifelong learning [14]. Teaching students about how to learn has been demonstrated to be effective to improve students' achievement and attitudes in various learning domains [8, 13]. However, little research explored the strategies specifically for searching information in the WWW.

Hill [5] described a conceptual framework for how users formulate and employ information-seeking

strategies in open-ended information systems (OEISs), e.g. the Internet. Two stages of information seeking were presented in this model. The first was navigational stage, which included the following processes: purposeful thinking, acting, and system responding. The second was process stage, including evaluation, transformation and integration, and resolution. With limited metacognitive ability and unawareness of computer application skills, novice users tended to suffer information overloading. They often repeated the behaviors which were recognized in the navigational stage, but seldom performed the actions belonged to the process stage. However, experienced users were able to utilize the searching strategies that were recognized in both stages [5]. They also showed how to control and manage their searching process. It seemed that users' self-awareness about their own searching ability, self-reflection, self-control and self-management about their searching process were keys for successfully seeking information on the Internet.

In order to become lifelong learners, all citizens of the next century must know what strategies they can use for searching information effectively and efficiently on the WWW and how to use them. If the Internet is an important vehicle for lifelong learning, then identifying effective WWW searching strategies should be the first step to reach the goal.

2 Purpose

The purpose of this study was to identify effective WWW information-seeking strategies by comparing the strategies used by Internet novice users and experienced users. Therefore, the research question of this study was: What are the differences between the strategies used by Internet novice users and those used by Internet experienced users while searching information on the WWW?

3 Methodology

Two in-deep case studies followed by a between-case comparison were used to answer the research question. A college freshman, as an Internet novice user, and a college graduate working at a computer technology company, as an Internet expert user, were volunteered to participate this study. Both subjects were asked to perform a searching task alone through the WWW by using a web browser, Internet Explorer. The goal of the task was to find a freshmen course schedule of a specific department in a large university in Taiwan. The searching processes were both videotaped for observing subjects' searching paths, number of websites visited, and the time spent on each site. During the search, subjects were asked and continuously reminded to perform think-aloud in order to collect verbal information for protocol analysis [3] of their searching strategies. Pencils and blank answer sheets were issued to subjects for taking notes or answers.

Before searching, a survey was administered to collect subjects' Internet background, including their Internet using history, frequencies of Internet access, Internet access availability at home, Internet courses taken before, and self-efficacy about searching information on the WWW. Right after the searching task, subjects were given another survey to reflect their self-satisfaction toward their performance in the task. Subjects were further interviewed by the researcher if there was a need to clarify on the videotape. Subjects' searching paths, actions, responses, and think-aloud protocols were analyzed for each case and then compared between cases.

4 Results

Comparing the data collected from pre-task and post-task surveys, searching paths, verbal scripts and blank answer sheets, several different characteristics showed between the Internet novice user and expert user. First of all, the expert finished the task and got desired information after visiting 30 in 18 minutes, whereas the novice visited 19 websites in 24 minutes with a blank answer. Except for different searching results between the cases, this also showed that the expert's navigating speed was as about twice as the novice's. In addition, the expert spent less than one minute on each website, whereas the novice spent more than one minutes on five websites. This indicated that the expert processed and evaluated the information shown on computer screen much faster than the novice.

Besides, verbal scripts to complaint about system like "I hate it! It is so slow.." or to critique the website

design like "This is a poor website full of redundant information..." showed 9 times during the expert's searching and 0 during the novice's; however, anxiety or worrying responses like "How come I cannot find it..." or " I cannot..I cannot..I just cannot find it..." showed 12 times during the novice's searching but 0 during the expert's. This suggested that the expert was confident to and believed being able to find the desired information; however, the novice users were coping with tremendous amount of anxiety toward reaching the goal of the task. This was concurred with their reflections in pre-task survey about their self-efficacies toward using computer technology.

Furthermore, navigation disorientation and system problems did not happen during the expert's searching process, but happened in the novice's searching process. The novice responses with "I understand it but just don't know where to start..." "How did I get here..." and "Oh! My god. I made a mistake. What's wrong with this?" This revealed that the novice user tended to get lost and became nervous after an error occurred. However, the expert showed confidence in controlling and regulating their searching process no matter what happened in the process.

Finally, the expert was familiar with how to use search engines and data base query systems; however, the novice showed some problems with them. This implied that knowing how to use helpful searching tools on the WWW is an important issue for successful searching. Besides, the novice showed little try-and-error strategies when problems occurred; however, the expert used this strategy a lot when a bottle net occurred. This indicated that try-and-error was an important problem solving skill for a successful searching in the WWW.

5 Discussions

Based on the results of this study, the differences of strategies utilized by the Internet novice user and the expert user can be summarized as following six aspects: computer self-efficacy, task anxiety, search aids, information processing, concentration, and problem solving. Computer self-efficacy [11] means how users perceived their abilities toward utilizing computer technology. The expert user tended to have higher computer self-efficacy than the novice user. This strategy relates to users' prior computer experience and believes about learning computers. Changing the novice users' views or believes about their computer abilities might be a solution to enhance their searching effectiveness and efficiency.

Task anxiety refers to worrying about not being able to reach the goal of a searching task. This strategy relates to environmental expectation and support. Group searching task with peer support might be a solution to help the novice search information on the WWW. Search aids indicates to users' knowledge and abilities to use tools that help search on the WWW, e.g. search engines and data base query systems. This relates to users' prior-knowledge and experience of using a data retrieval system. Providing a metaphor of such a system and practicing the query skills could enhance the novice users' abilities in this aspect.

Information processing refers to the ability to read in information from computer screen, select main ideas, evaluate, transfer, and integrate the information, and finally make decisions for the next destination. Strategies like looking through headlines and hyperlinks immediately after visiting a web page could help novice users to encode web information. Except encoding, many other strategies belong to this aspect. They include differentiating, monitoring, formulating, integrating, extracting, angling, collecting, controlling, decision-making, and reflecting [5]. In addition, this study shows evidence to support Hill's [5] conceptual framework of seeking information in an open-ended information system. Because the novice did repeat the behaviors of the navigational stage [5], but seldom performed the actions belonged to the process stage [5]; however, the expert in this study did perform the actions of both stages and show how to control and manage his searching process.

Concentration means the ability to keep attention on the searching task. The novice was easy to be interrupted by unrelated program messages or outside interferes. Have the mouse pointing to text which is currently being processed or read the text loudly might help the novice concentration on searching task. Problem solving means the ability to use try-and-error strategy when problems occur during searching. This strategy relates to users' creativity and problem solving styles. This strategy may be enhanced by successful practice experience.

6 Conclusions

The Internet novice users and expert users utilize different strategies to seek information in the WWW, an open-ended information system. Although the system design and users' system knowledge and domain knowledge may influence users' searching efficacy, users' metacognitive searching strategies may be enhanced through teaching and practice. By comparing the novice's and the expert's strategies used for seeking desired information through the WWW, this study identified six different aspects: computer self-efficacy, task anxiety, search aids, information processing, concentration, and problem solving. Future research should further investigate each aspect and examine the effects of the training of these strategies on users' searching efficacy.

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The Internet-based Educational Resources of the U.S. Federal Government

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The Internet is an international computer network composed of thousands of smaller networks. Recently, through United States federal, state, and regional education networks and commercial providers, the vast resources of the Internet are increasingly available to administrators, school library media specialists, and classroom teachers. The web puts learning within the reach of anyone with Internet access. One of the most popular uses of this new medium, among teachers, is searching for ways to help students learn. But finding the right information on a particular topic for their students takes time. Current initiatives, such as FREE, GEM, ERIC, and Parents Guide to the Internet, meet this goal of improving online learning resources. This paper aims to introduce some of the United States' successful programs.

1 Introduction

One of the main priorities of the Clinton administration is to make sure that all Americans have the best education in the world. One of the goals of this "Call to Action for American Education" is to bring the power of the Information Age into all schools in the United States. This initiative requires connecting every classroom and library to the Internet, making sure that every child has access to multimedia computers, giving teachers the training they need to be as comfortable with the computer as they are with the chalkboard, and increasing the availability of high-quality educational content. When America meets the challenge of making every child technologically literate, children in rural towns, suburbs, and inner city schools will have equal access to the same knowledge base.

United States Federal agencies have made significant contributions to expanding this knowledge base. For example, "White House for Kids," is a home page with information on the history of the White House. NASA has a K-12 initiative, allowing students to interact with astronauts and to share in the excitement of scientific pursuits such as the exploration of Mars and Jupiter, and the experiments conducted on the Space Shuttle. Students participating in the GLOBE project (Global Learning and Observation for a Better Environment) collect actual atmospheric, aquatic, and biological data and use the Internet to share, analyze, and discuss the data with scientists and students all over the world. With support from the National Science Foundation, the Department of Energy, and the Department of Defense's CAETI program (Computer-Aided Education and Training Initiative), the Lawrence Berkeley Laboratory has developed a program that allows high school students to request and down-load their own observations of the universe from professional telescopes.

Of these government programs, four of these are as follows:

2 FREE (Federal Resources for Educational Excellence)

On April 18, 1997, President Clinton asked Federal agencies to determine what "resources you can make available that would enrich the Internet as a tool for teaching and learning." In response, more than 40

Federal agencies formed a working group to make hundreds of federally supported education resources available on the FREE website.

Some of the subjects of the FREE include arts, educational technology, foreign languages, health and safety, and mathematics. Agencies involved include Centers for Disease Control and Prevention, National Gallery of Art, National Science Foundation, Peace Corps, Consumer Product Safety Commission, and the Smithsonian Institution.

3 GEM (Gateway to Educational Materials)

GEM began in 1996 after the National Library of Education (NLE) Advisory Task Force sought to find ways to apply library and information science skills to help educators find lesson plans and teacher guides on the Internet. GEM provides links to free Internet materials, partially free materials, and to resources that require a fee or registration to be used. There are two ways to access the education resources on GEM —Browsing and Searching. Browsing GEM is sampling from lists of predetermined categories (e.g. mathematics, language, education by grade level). Searching GEM is looking for any information containing the keywords of the query (e.g. algebra lesson plan). This website provides access to educational materials found on various federal, state, university, non-profit, and commercial Internet sites.

4 ERIC (Educational Resources Information Center)

The Ask ERIC service (Education Resources Information Center), supported by the Department of Education, has a virtual library of more than 900 lesson plans for K-12 teachers, and provides answers to questions from educators within 48 hours -- using a nationwide network of experts and databases of the latest research. Abstracts of some 1,300 (Educational Research Information Center) ERIC Digests are available online and text-searchable. A menu of services offered on the Internet not only introduces the user to ERIC documents, but also leads to other databases in education. It began in 1992 as a project of the ERIC Clearinghouse on Information and Technology and is now, with the ERIC Clearinghouse, a component of the Information Institute of Syracuse at Syracuse University. Today, Ask ERIC encompasses the resources of the entire ERIC system and beyond. Got an education question? Ask ERIC! The main components of Ask ERIC are:

1. Ask ERIC Question & Answer (Q&A) Service
   Need to know the latest information on special education, curriculum development or other education topics? Just Ask ERIC! When you submit your education question to Ask ERIC Q&A, you' ll receive a personal e-mail response from one of our network information specialists within two business days! We will send you a list of ERIC database citations that deal with your topic and will also refer you to other Internet resources for additional information. It' s that easy!

2. Ask ERIC Virtual Library
   The Ask ERIC Virtual Library contains selected educational resources, including 1000+ Ask ERIC Lesson Plans, 250+ Ask ERIC Info Guides, searchable archives of education-related listservs, links to Television Series Companion Guides, and much more!

3. Search the ERIC Database
   The ERIC database, the world' s largest source of education information, contains more than one million abstracts of documents and journal articles on education research and practice. By searching Ask ERIC' s web-based version of the ERIC Database, you can access the ERIC abstracts, which are also found in the printed medium, Resources in Education and Current Index to Journals in Education. The database is updated monthly, ensuring that the information you receive is timely and accurate.

5 Parents Guide to the Internet (16 page informational booklet)

This new, 16-page booklet, produced by the U.S. Department of Education, gives parents an introduction to the Internet and is "intended to help parents --regardless of their level of technological know-how--make use of the on-line world as an important educational tool. The guide cuts through the overwhelming amount of

consumer information to give parents an introduction to the Internet and how to navigate it. Most importantly the guide suggests how parents can allow their children to tap into the wonders of the Internet while safeguarding them from its potential hazards.

This guide was produced with the sort of collaborative effort that American schools need in order to succeed. U.S. Department of Education staff worked with leaders from parent and education organizations, the private sector, nonprofit groups and others in order to give parents a clear and comprehensive overview of the Internet and its vast educational potential. In the same way, schools need support from every corner of the community in order to provide students with a high-quality education.

6 Conclusion

More than ever before, a high-quality education offers Americans the best path to a rewarding career and a fulfilling quality of life. As citizens of the Information Age, Americans must include access to technology among the elements of an education that is based on high standards of achievement and discipline. But incorporating technology into the Nation's schools is too big a job for the schools to tackle on their own. Teachers need support and involvement from parents, grandparents, businesses, cultural institutions and others in order to make effective in-class use of the wonders of technology.

The Internet is an international computer network composed of thousands of smaller networks. Recently, through United States federal, state, and regional education networks and commercial providers, the vast resources of the Internet are increasingly available to administrators, school library media specialists, and classroom teachers. The web puts learning within the reach of anyone with Internet access. One of the most popular uses of this new medium, among teachers, is searching for ways to help students learn. But finding the right resource on a particular topic for their students takes time. And time is in short supply for our teachers. Current initiatives, such as those outlined, FREE, GEM, ERIC, and Parents Guide to the Internet, meet this goal of improving online learning.

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Which Chinese Input Methods Is More Suitable for Sixth-Grade Pupils? Keyboarding or Non-Keyboarding

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Computers have been wildly used in elementary schools and to input characters is usually necessary while manipulating computers. However, inputting Chinese characters is a burden for Taiwanese pupils. Keyboarding is a traditional method used for inputting Chinese characters. On the other hand, other user-friendlier input tools like speech and handwriting recognition provide alternative choices. We observe three 12-year-old pupils, who have different backgrounds, how they use these different methods to input Chinese characters. Experiments results show that all three pupils make progress after short-time practice for all input methods. Different pupils, however, would choose different input method depending on their own preference and background.

Keywords: **Chinese input method, keyboarding input by pronunciation, speech recognition, handwriting recognition**

1 Introduction

Computers have been widely used in many educational applications like computer-aided learning. For a pupil in Taiwan, one of obstacles that he or she may encounter for using computers is to input Chinese characters.[1] In this study, we intend to explore pupils' behaviors on Chinese characters inputting and then make recommendations in under what conditions what kind of input methods may be used.

Keyboarding and non-keyboarding are two main categories of characters input methods. For keyboarding method, users type Chinese characters either according to their pronunciations or by "dismantling" the characters. For the non-keyboarding methods, handwriting and speech reorganization are two popular methods for inputting Chinese. While keyboarding has been used for longer time and almost always each computer is equipped with a keyboard, non-keyboarding input methods are developed recently and extra equipments and software are needed.

When keyboarding is used, most students input each single Chinese character by spelling its pronunciation.[5] Main reasons are: (1) Students are familiar with the pronunciation. What they have to learn is to memorize the position of each key on the keyboard corresponding to the pronunciations. (2) Psychology indicates that human beings think in the form of tone (of characters), but not the font of the characters.[4] However, disadvantages of this input method exist. (1) Students may not spell pronunciation correctly especially when they encounter new words. (2) Many different Chinese characters have same pronunciations.[3,7] Pupils thus need to choose the target character and the input speed is slowed down. Non-keyboarding input methods, especial the voice reorganization, is one of the hottest research topic in computing. People use natural ways like handwriting or speech to communicate with computers. The computers then analyzed the data to identify what people mean and output the data in a text format.[6]

We conduct the study to find out pros and cons of each input methods. Three sixth grade (12-year-old) students with different computing backgrounds are chosen, based on interviewing and simple tests. Student A has a lot of computing experience, student C has little computing experience, and Student B is in between. All three students come from National Tainan Teachers College Affiliated Primary School. For keyboarding input, they use the input method of spelling words' pronunciation that is included in the Windows 98

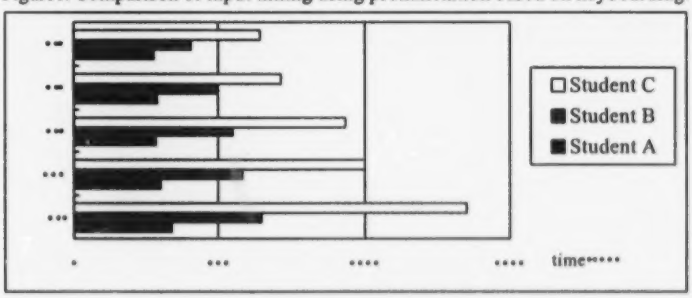
operation system. For handwriting reorganization, they use "Pen Power Jr." For speech reorganization, they use the product named "IBM ViaVoice." The essay that students input is extracted from the newspaper China Times. There are 142 characters in the essay. To evaluate the performance of different input methods, each pupil has five chances to input the Chinese essay by pronunciation based keyboarding, speech reorganization and handwriting reorganization. Between each of chance, they have a period of 30 minutes to practice. In the next section, we summarize our observations and statistical results toward the problems in each of the sub-sections.

2 Findings and discussion

2.1 Can short-time trainings improve performance of pronunciation based keyboarding?

Figure 1 shows timing in seconds that student A, B, C took to finish the essay in five trials. They are asked to input all characters correctly. All three pupils made progress for the short-time practice. Comparing the first and the fifth performances, we found that student A, B, and C had 19%, 37%, and 53% of progress, respectively. Although student A made less progress, the student actually finished the essay quickest. Beside, students A, B, and C had an average progress of 16, 60, 178 seconds. We noticed that both student B and C kept making progress, but student A had a downgrading performance from the third to the forth trial. The difference between the third and forth trial for student A, however, is not significant. Based on the experimental results, we conclude that short time training does benefit three students in different background. Furthermore, the student with the least computing background actually made the most significant progress.

Figure1. Comparison of input timing using pronunciation based on keyboarding.



2.2 How does the speech recognition input method affect the input efficiency?

Figure 2 shows the percentage of the speech recognition software correctly identify the characters. Both student A and B perform similar from the first to the fifth trial, while student B tends to be better in the first of four trials. Besides, student B makes a great progress from the first trial (77%) to the second trial (92%). Student A and B reached a 100% correct recognition and student C achieved almost 90% correctness. This suggests that, after reasonable training, students with different background can manipulate the speech input method nicely.

Figure 2. The correct recognition percentage of speech recognition.

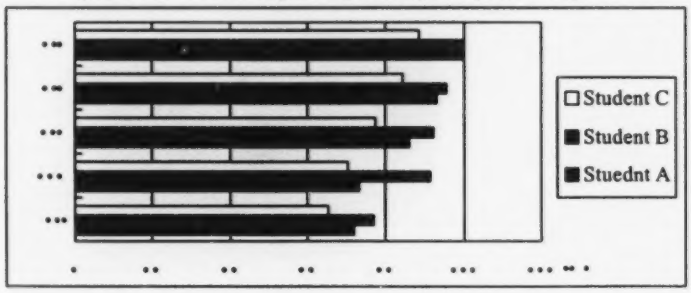
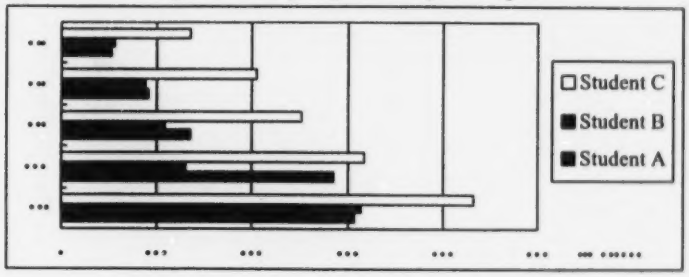


Figure 3 demonstrate timing the pupils took in five trials with emending the wrong characters. When the correct recognition rate is high, the input method can be very efficient, about 160 characters in one minute for student A and B. However, this is not a universal situation. Take student C as the example, the pupil speaks in such an ambiguous tone that the computer simply could not correctly recognize the essay. As the result, the student spent a lot of time to emend the wrong characters and greatly slow down the speed of inputting. Such observations show that there is room for improving the correct recognition rate.

Figure 3. Timing of speech recognition input.



2.3 How does the handwriting recognition input method affect the input efficiency?

Figure 4 reveals the percentage of the handwriting recognition software correctly identify the characters. Both student A and B perform similar from the first to the fifth trial, while student B tends to be better. Besides, student B reached 100% correct recognition at the last two trials, and student C achieved 92% correctness. This suggests that, after reasonable training, students with different background can manipulate the handwriting recognition input method nicely.

Figure 4. The correct recognition percentage of handwritten recognition.

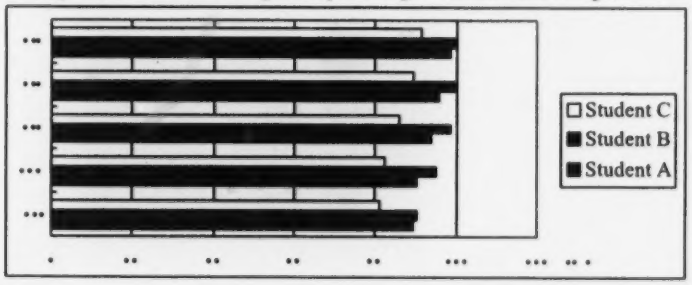
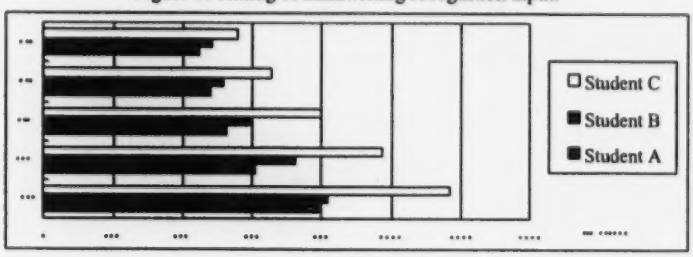


Figure 5 demonstrate timing the pupils took in five trials with emending the wrong characters. We find that both student B and A perform similarly and nicely, though slight differences exist. Main reason why student B outperforms other two students at the correct recognition percentage is the way he wrote Chinese characters. Student B usually writes in a way that the characters strokes are clear and distinct. In contrast, student C tends to write Chinese characters apart and thus make the software consider as several words. Furthermore, student A writes very fast and his written characters strokes are also clear, though a little behind the ones of student B. This characteristic affect the timing of input, while the correct recognition percentage of student A is lower than B, he should took more time in inputting, instead, the timing of input with emending is less than that of student B.

Figure 5. Timing of handwriting recognition input.



2.4 For different students, how the input methods help students to input more efficiently?

For student A, to use keyboarding as input tool is better than the one by non-keyboarding. Because he is familiar with keyboarding and input Chinese even becomes a basic ability as using computer.[2] So that in the test of keyboarding, he exceeded others very much at first, but just for the same reason, he could not make further progress. In inputting by non-keyboarding methods, he did not do such a good job as keyboarding. Take speech for instance, everyone spent almost the same time when they did not need to emend the wrong words, but he spent much more time then student B when emending is needed. Similar result can be found for handwriting method. The recognition rate of student B is better than A.

For student B, to use non-keyboarding as input tool is better than the one by keyboarding. One reason is that he is not as familiar with keyboarding as A does. He usually uses computer to play games or surf the Internet. He actually just needs to use mouse as a tool to communicate with computer. In keyboarding, although his effect is not better than student A, but he has a better progress than student A. If non-keyboarding method is used, no matter speech or handwriting, he did a better job than student A and C. We emphasize that, these three students never use speech or handwritten before, and the result shows that the learning effect of student B is better than the other two students.

For student C, to use keyboarding seems better than non-keyboarding. He made a better progress in keyboarding. In input method of keyboarding, at the last time of test, his input time was even less than that of student B's first trial. This result showed that after short-time training, student C made the greatest progress in keyboarding (53%). For non-keyboarding methods, student C seems had difficulty to adjust his speech tone and handwriting to fit the software. But we think this is the place that software developers should work on. It should be the software developers' responsibility to develop software that is capable of adapting different speech tone and handwriting habit.

3 Conclusions

We have observed the behaviors of using keyboarding and non-keyboarding Chinese input methods. We suggest the following. For students who are familiar with computer and takes inputting as a basic skill, like student A, keyboarding best fits. For those who learn new things very fast, are interested in them, and speak or write well, (like student B) then the non-keyboarding is fit. For a student like the C, who does not learn new things very well and maybe he does not speak or write well, and he is used to input by keyboard, then the keyboarding is fit.

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